Effectiveness of Virtual Reality in Gamers Versus Non-Gamers

An Honors Thesis (HONR 499)

by

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Abstract

In 2013, a new generation of consumer virtual reality systems began to be developed and marketed towards people with experience playing 3D video games. Since then, the consumer virtual reality market has increased dramatically with many virtual reality devices and pieces of software being available on the market today with gamers still being a focus of much of the market. While a lot of research has gone into virtual reality over the years, little of it has focused on whether or not gamers experience virtual reality in a different way than people without experience playing video games. This paper explores research that has been conducted on virtual reality through this lens and asserts that more experimental research should be conducted with virtual reality's effectiveness with gamers and non-gamers as this may dramatically influence the direction of virtual reality hardware and software in the coming years.

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Process Analysis Statement

Virtual Reality has been a topic of interest for me since I was young. My first exposure to the idea of virtual reality as we see it today was in the Walt Disney World Ride *Carousel of Progress*. The ride portrayed an average American family through the 20th century and ended on a scene that represented the vision of an American family in the future. This final scene included voice controlled lights, Laserdiscs, a high definition television, and a set of home virtual reality goggles and gloves. This was my first real exposure to virtual reality as well as the one piece of media that would shape my view of the future the most for my life until this point. It was incredible to watch as all of these innovations came into fruition and I was able to own them in my home. I have a voice activation device that can turn my lights on and off. In fact, I can say certain phrases in my apartment and my high definition television will turn on and a high definition movie will start playing. And, as of last summer, I have been able to strap on a pair of virtual reality goggles, pick up some tracked motion controllers and take part in a home virtual reality experience.

Since I have been very excited for virtual reality for a long time, doing anything in virtual reality is thrilling for me. It is also something that I think is very cool and love to share when given the opportunity even though the current generation of consumer virtual reality devices are far from perfect. Because of this, I have been able to witness a variety of people's reactions to virtual reality experiences. I have seen my parents, relatives, and friends all try out virtual reality and have a large range of reactions. I watched the differences in reactions between older people and younger people and people with varying levels of technological experience. The most interesting difference that I witnessed in these informal observations was the difference in reactions to virtual reality between the people who were experienced in playing video games

versus the people who had less experience. I noticed that people of the same age who had less experience playing video games were more taken aback by these virtual reality experiences. Gamers enjoyed the virtual reality experiences quite a bit, but the non-gamers more often than not seemed to have a sense of wonder at the experience that the gamers often lacked. There were some things that stayed the same, such as the high percentage of gamers and non-gamers that at one point or another attempted to lean on a virtual table only to lose their balance temporarily in real life.

The gamers, however, seemed to be very goal driven in the virtual reality experiences. This made sense to me at the time because it seemed natural. Video games are (generally) goal based programs on a screen that a user interacts with in certain ways with some sort of controller in order to achieve some sort of win state in the game. These virtual reality experiences were computer programs on a screen (very close to the users face) that allowed user interaction with some sort of controller. The difference here was that many of the virtual reality experiences that I showed people in these meetings were not goal based. There was not a win state, the goal was to witness and interact with an environment and feel immersed. In general, these experiences weren't as interesting to the gamers. They looked around for a bit, played with whatever was able to be interacted with for a minute or two, and then usually asked if there was anything else. The non-gamers, on the other hand, wanted to spend much more time in these experiences than in the more goal based experiences or games. These people were impressed with and studied the scenery in locations, painted in 3D space, and would spend hours playing with small interaction elements such as a ping pong paddle and ball. The gamers, for the most part, seemed more apt to see virtual reality as a tool rather than a window into another world.

This really interested me and make me think extensively about how I saw and experienced virtual reality. I started to wonder if I felt like I was in the virtual space as much as some of the people who I observed who would sit with jaw on the floor looking around and admiring the environment. I thought about what I wanted to get out of my virtual reality experience and why I felt like it was important to not think of these experiences as games in the traditional sense. There was something exhilarating and fun about dodging bullets and reaching the end of a game level in one of the virtual reality games that I played (one that was particularly popular with the gamers I observed). However, to be good at the game I noticed that I had some sort of mental shift take place. I had to remove myself from the virtual situation and think of it as if my body was merely a controller in a video game and I was controlling a character in a game. Without this, I spent more time looking around the environments and feeling the rushes of excitement that dodging bullets gives you. But once I got into "gaming mode," I found myself having less wonder at the environment and experience in general and focusing more on achieving the predetermined win state of the game. In my mind, this wasn't the true purpose of virtual reality. In my mind, visualizing and being able to interact with virtual objects in 3D space could be a useful tool, but the purpose of virtual reality was to transport your mind to a different world.

Witnessing these differences in experience in virtual reality in others as well as myself made me curious to see if anyone else had witnessed this and perhaps studied this possible effect of a gaming mindset in virtual reality before. It was at this point that I set out studying research on virtual reality. One thing that I immediately noticed was the amount of research that had been done long before modern virtual reality devices were available or even technologically possible. It was at this point that I believed the best course of action was to use this thesis as a way to

conduct experimental research on various groups of people and witness their reactions in virtual reality to try to see if there was truly a difference between how gamers and non-gamers experienced virtual reality.

This plan was halted for a few reasons. One reason was that I experimented more with my own virtual reality system and continued to notice flaws, inconsistencies, and other issues that would make having uniform tests with virtual reality difficult. There was also some trouble in quantifying what immersion is as well as the possibility of the results being influenced by the low graphical fidelity of the virtual reality headset and other technological issues rather than differences between mindsets in different audiences. In the process of planning this I also discovered the papers released from the IEEE virtual reality conferences from the past few years. I realized at this point that while I did not have the resources or technology to perform useful experiments myself, there was enough research that was similar to my proposed experiment to make a case that more research should be done into this specific area. I wrote this thesis to attempt to investigate further into my informal observations that seemed to indicate that there might be a difference in how gamers and non-gamers experience virtual reality. It was interesting and exciting to find studies and papers that seemed to indirectly indicate that my theory could be a possibility and I am excited to keep up with this research and possibly research this idea more in the future.

Effectiveness of Virtual Reality in Gamers Versus Non-Gamers

I. Introduction

Virtual reality (VR) technology and experiences have been physically prototyped since the 1950s when Morton Heilig created the Sensorama. The Sensorama was one of the first devices that was meant to give a personal immersive film viewing experience by taking advantage of the viewer's senses. Heilig believed that enveloping each of the viewer's senses would cause the fourth wall of film and theater to dissolve and transport the audience into a virtual world thereby creating a type of "experience theater" [1]. In the decades following Heilig's failed Sensorama, there were other various attempts to describe and create a virtual reality experience. While many of the consumer virtual reality products either failed commercially or failed to make it to the market, several pop culture depictions of virtual reality such as those in *The Matrix* and *Star Trek: The Next Generation* gained significant popularity and attention.

However, the current wave of virtual reality devices, experiences, and interest has been centered around virtual reality as a video game device. While there are now many virtual reality headsets of some type on the market today, this wave was spurred by the successful Kickstarter campaign for the Oculus Rift. Specifically called "Oculus Rift: Step Into the Game", this was, as of April 2017, one of the most funded Kickstarter campaigns of all time, raising $2,437,429 in August of 2012 [2]. This was a campaign that was marketed towards and funded by players of traditional video games. The campaign video even states that the headset is "designed very specifically for gaming." Shortly after this campaign was funded, prototypes of this virtual reality headset started being shipped out to the project backers, primarily gamers and people in the gaming industry, and it became, in a sense, the first widespread consumer virtual reality

platform of the 2010s. In this time before other headsets and systems were released, the backers of this project created nearly all the software and experiences for the headset. Since these backers were primarily gamers, many of these experiences resembled traditional video games in some way with several of the available experiences being "ports" of existing video games. When the first widespread consumer version of the Oculus Rift and its competitor the HTC Vive were released in spring 2016, the majority of available software was PC virtual reality was still being affected by the past 4 years of software development and previous marketing that were both centered around traditional video game players.

While these devices are considered the most advanced consumer virtual reality systems available at the time of writing this paper, there are other less expensive and less advanced virtual reality consumer solutions that have been marketed to different audiences. Most notable of these is the series of Google Cardboard inspired devices that range from $5 to $60 in price and allow the consumer to use their existing mobile phone as the virtual reality hardware platform as well as screen [3]. While these are often targeted towards non-gamers, the software and hardware for these devices is decidedly less advanced and further away from the "current generation" of virtual reality experiences that a user can interact with using the HTC Vive or Oculus Rift. Unlike the Google Cardboard and other mobile phone virtual reality systems, the HTC Vive and Oculus Rift allow for "hand presence" in the virtual world [4]. Hand presence involves tracking a user's hands and mapping them into the virtual world that is being displayed through the user's headset. For example, if a virtual object is perceived to be half a meter in front of the user through their view in the headset, the object will only react to a virtual touch from the player if their hand is placed half a meter in front of them in the actual physical space. This means that a

user (generally holding a type of wireless controller in their hands) can interact with objects in the virtual world in a similar fashion to how they would outside of virtual reality.

There are other differences between these two types of virtual reality system types such as graphical capability and non-mobile virtual reality's wider range of sensors and controllers which allow a user to walk around in a virtual space by moving their body and interact with a virtual space in a richer way than in mobile virtual reality. Because of these important differences between mobile virtual reality and the advanced, gaming-based, room-scale virtual reality, as well as the cost of entry to these advanced systems that can be somewhat alleviated if a potential user already plays traditional video games on PC, it can be deduced that many the users of modern, room-scale virtual reality devices and experiences are people who have had some experience playing a modern video game. There is high likelihood that room-scale virtual reality will continue going down this path of catering to gamers. Are gamers truly the best market for virtual reality? In 2016, total PC virtual reality revenue was $718,000,000,000 [5]. This is almost exclusively revenue based around these two, gamer-centric, virtual reality devices. In this way, gamers have shown that they are willing to be virtual reality consumers. For many gamers, virtual reality is simply a natural extension of their video gaming setup.

This paper attempts to examine research that has been conducted regarding virtual reality through the lens of attempting to find any possible differences between the experiences using virtual reality between people with experience playing 3D video games (gamers) and people who have not (non-gamers). While the research provided does not offer definitive proof that gamers and non-gamers experience virtual reality in profoundly different ways, this idea seems to be a possible explanation for many of the results of the studies that have already taken place and further experimental research into the effectiveness of virtual reality between these two

audiences may elucidate these differences and possibly impact the direction of the virtual reality market in the future.

II. Current Virtual Reality Research

There is some evidence already that points to the idea that gamers could have more difficulty in a virtual reality system than non-gamers. This comes in a 1997 study that presented users with a task that involved searching for a certain letter in a virtual environment full of different letters. The researchers set up the same task in a head mounted virtual reality system and a traditional desktop monitor setup. Some participants performed the task in the virtual reality system first and then used the desktop interface while some participants performed in opposite order. The researched observed that users who had used the virtual reality system first and then switched to the desktop system performed the task faster than those who had only used the desktop system. More importantly, they found that people who had used the desktop system and then switched to the virtual reality system performed the task slower than those who had started in the virtual reality system [6]. However, these results are observing users with short term experience with both systems. They do show that there is a relationship in a user's mind between a program on a desktop and the same program in a virtual reality system and that this relationship does affect performance. This study was conducted in 1997. This was a time when "gamers" didn't have too much experience playing games that simulated 3D environments like the one presented in the study. Because of that, if there is in fact a correlation between modern gamers and virtual reality experience and performance, there likely would be no noticeable differences in the study if the participants had been split into categories of gamers and non-gamers. Today, games are more like the type of experience that was tested in this study (navigating and observing a virtual 3D space often from the perspective of a character in that

space). To fully interpret this result, it would be interesting to what would happen if participants were given one task (task a) to accomplish on a desktop interface and then a separate, but similar, task (task b) in virtual reality. Then repeat the process with different participants in different configurations (task a in virtual reality then task b on a desktop and task b on a desktop then task a in virtual reality for example). Ideally both of these tasks would deal with navigating and interacting with a 3-dimensional virtual world as the task in the original study did. This might help illuminate whether or not the negative performance results shown in the study are more of a consequence of performing the same task on a desktop system first then virtual reality or whether the results indicate that any experience navigating and accomplish tasks virtual 3D worlds on a traditional desktop system is linked to a decrease in ability to solve tasks in a virtual 3D world in a virtual reality system. Either way, this proposed study would simply show the effects of short term experience in traditional usage of 3D virtual worlds rather than the differences between long term experience in this area that today's modern gamer would have.

Someone who has played video games could be naturally less invested in virtual reality experiences as a result of their past experience playing video games. A study compared the emotional response of gamers vs non-gamers in virtual reality. The experience the participants were put in was one meant to induce several negative emotions such as fear, anguish, and surprise. In this experiment, the user controlled the movement of the experience using a USB controller. The people using the headset were able to move through the virtual setting using the controller and the display on their virtual reality head mounted display reflected the movement through virtual space. The gamers recruited for this experiment said that they had experience playing first person shooter video games. In these video games, a user watches a screen and the images on the screen are from the perspective of an unseen character in the game as the user

controls the characters movement and actions. In this sense, the virtual reality experience was similarly through the eyes of an unseen character similar to the first person shooter games.

In this experiment, there were several events that would happen in the virtual reality experience that were meant to induce fear. The results showed that the gamers with experience in playing first person shooters rated feeling significantly less fear in their experience than people who stated they had no experience playing 3D video games [7]. While, on some level, this may be seen as a positive for gamers as they were not negatively emotionally affected by the virtual reality experience, the study did not measure positive emotions. It is perhaps likely that the gamers would also not experience as high levels of positive emotions as the non-gamers as well. What this also points to is perhaps the idea that the gamers did not feel emotionally invested in the virtual reality experience. This may be a result of the gamer participants not being as immersed in the virtual reality experience as the non-gamer participants. Particularly with the emotion of fear, as tested in this study, this could be a result of the gamers detaching themselves from what they are witnessing and interacting with in the virtual world. Perhaps this could be a result of their prior experience with video games.

In video games, the user generally controls and witnesses a virtual world through the perspective of a fictional character in the game world. Even if a gamer cannot see the character and instead is displayed visuals on-screen from the character's perspective, as in the first-person shooters that the participants in this study said they had experience playing, the gamer is used to this paradigm of controlling a character and they must understand that they are viewing and manipulating the virtual world from the perspective of a character in order to be successful at the game. For the most part, virtual reality experiences are meant to be different from this. Generally, the goal of most virtual reality experiences is to make the user feel as though they are

the subject in the virtual world who is viewing and manipulating the virtual world around them. Perhaps these gamers who felt less of an emotional response were not mentally viewing themselves in the virtual reality environment. Perhaps instead they were relying on their existing ideas of manipulating virtual worlds in video games where they control a character who is detached from themselves. In first person shooter games, the gamer is forced to confront the fact that, while the character they are controlling onscreen is in significant danger and often killed onscreen, they are not in any actual danger. This may help explain why the gamers in the experiment did not experience the emotions of fear while in the virtual reality experience.

The gamers in the experiment had the concept and experience of a video game to mentally fall back on when faced with fear inducing virtual elements. The non-gamers had less experience in controlling a character through terrifying situations in a virtual 3D space and, because of this, they reacted with fear when they saw virtual terrifying events unfold. Whether the gamers truly considered the virtual reality experience as just a video game is not entirely clear. There is a possibility that they only started detaching themselves as a mental defense mechanism from the situation when a fear enduing moment started to occur in the experience. However, it could be the case that the gamers never truly witness virtual reality as a virtualization of experiences happening to them and that they instead view virtual reality as a view into a character's experiences, similar to video games. The question remains whether or not non-gamers see virtual reality as an extension of their own experiences.

For some, virtual reality does seem to feel like an extension of one's own personal experiences. This is evidenced by successful arachnophobia treatments done through virtual reality. In 2002, a group of people who were tested as having a phobia of spiders were subjected to an average of four virtual reality sessions with virtual spiders meant to cure the subjects of

their fear. At the end of the sessions, 83% of the patients who used the virtual reality treatment were shown to have had their arachnophobia lessened [8]. This seems to indicate that the users in this study considered the virtual world that were experiencing as some sort of extension of their own experiences rather than simply controlling a character with no consequence on their own life. It would be interesting to see if the subjects in the cases where the virtual reality treatment was not effective for treating phobias had experience in 3D video games. This study was done in 2002, when 3D video game usage was not as advanced or mainstream as it is today. It would possibly be enlightening to see if the results would change if similar studies were done today with today's population consisting of a larger portion of gamers with experience with 3D virtual worlds. It is also interesting to note that fear was the emotion tested in the 1997 study that showed less of an emotional response in virtual reality in gamers. However, the fear that was tested in this instance was generally fear as a reaction to sudden unexpected virtual movements. This type of fear may be significantly different in experimental tests with gamers and non-gamers than the type of phobia fear that is studied in cases of arachnophobia.

There have been other studies on virtual reality treatment for phobias such as the fear of flying. A 2000 study compared virtual reality fear of flight therapy to more traditional methods of therapy. The virtual reality therapy was done in an office and consisted of sessions of the patient viewing a virtual airplane with virtual reality goggles while the virtual airplane took off, flew, and landed. During this, a therapist would control the virtual world as well as speak to the patient and make comments until the patient's anxiety lessened. The more traditional therapy that was being compared was one where a patient would be taken through an airport and the normal pre-flight activities and then put in an actual stationary airplane as a setting for the therapist's verbal treatment sessions. These two types of therapy were shown to have the same levels of

effectiveness [9]. The study mentions that the virtual reality treatment has the capability to be much less expensive than the traditional method of treatment. The study also mentions that "Some patients may not be able to overcome the fact that the exposure is not to the "real" stimulus, and we do not yet have information on what type of person constitutes a good candidate for VR versus in vivo exposure." This is the only information the study provides on who this treatment was and wasn't effective for. Perhaps, a possible explanation for this is that the people who couldn't overcome the fact that the treatment wasn't "real" were people who had been exposed and played the 3D games that were widely available and popular at the time like Super Mario 64 that was released in 1996. If there is truly a separation between the effectiveness of virtual reality therapy between gamers and non-gamers, these therapies could face major obstacles in the future as more people are gaining experience with video games and 3D games are becoming more accessible with the advancement of mobile phone technologies. While virtual reality technology is becoming more accessible and less expensive for therapy, virtual reality therapy could be becoming less effective.

One of the issues that may cause virtual reality to be less effective and immersive with gamers is gamer's possible tendency to compare the virtual reality experience to other 3D video games they have played. A 2007 study at Texas A&M University tested out 3 different types of interaction systems for seated virtual reality head rotation feedback [10]. They tested the standard 1-to-1 head tracking where the horizontal rotation of the head was portrayed with the same perspective difference in the virtual world. They tested a mode where the effects of head rotation in the virtual world was amplified to accommodate players who cannot make a full 360 degree rotation in their seats. They also tested a mode called guided head rotation. This mode manipulated the virtual environment without direct head rotation to encourage the user to turn

their head back to their starting position in physical space. The study found that people who participated in the study who had experience in 3D games adapted to the guided head rotation mode much better than the non-gamers in the study. The gamers also experienced less sickness from this mode than the non-gamers did. The guided head rotation mode is similar in effect to many 3D video game environments where the perspective of the viewer changes without their head physically moving as well as some of the pathfinding algorithms that are used in this mode. This unnatural form of view manipulation may have caused an immersion break in the non-gamers.

This difference in results may be due to the gamers viewing the virtual reality experiment as an extension or different type of 3D video game and therefore were less immersed and felt less personally involved and therefore were not negatively affected when the perspective changed without moving their head. This could also explain why they felt less sick afterwards. This could imply that the gamers are not as immersed in the virtual reality experience as the non-gamers. However, this cannot be certain as there could have been an immersion break in the gamers in the same way that it may have in the non-gamers but either way the gamers would have had the concepts they are accustomed to in 3D video games to fall back on to help them navigate in the virtual reality environment.

III. Virtual Reality Versus Video Games

Are video games inherently different than virtual reality? Does it necessarily matter if gamers have a different experience in virtual reality than non-gamers? It may be important in a few ways. One major way this possible difference could be important is because of the large percentage of video game experts that are shaping today's virtual reality field. Not only are a large portion of the users of virtual reality today experienced in playing traditional video games

(the 3 top selling non mobile virtual reality headsets have major ties to popular video game development companies), a large percentage of professionals developing software for virtual reality have worked with video games before as well. Part of this is a result of much of the software for developing virtual reality titles being nearly identical to software for developing 3D video games for computer systems. If there truly is a separation between how gamers and non-gamers experience virtual reality, no more research is done on this topic, and leaders in the virtual reality field are left in the dark about this separation, the current burgeoning consumer virtual reality market could face issues and possibly failures as it has in the past.

As mentioned before, traditional video game players are the target of much of the marketing and advertising for virtual reality systems and software. If research were to show that people who played video games were significantly less likely to be "immersed" or feel presence in virtual reality experiences, companies might want to shift their marketing and products towards different audiences quickly before virtual reality is discarded in the public's eye as not effective by an audience who is, due to preexisting behavior, less likely to be able to experience the medium's full effect.

There is also the other problem of developing hardware and software to meet the users' needs. If the industry is focused on gamers exclusively and the two groups of gamers and non-gamers have separate needs and desire in a virtual reality environment and software, the virtual reality industry could be accidentally ignoring potential users. As mentioned before, there could also be decreased effectiveness of virtual reality treatment in gamers. If this is the case and therapists are not aware of this, they could be apt to waste time, money, and resources on treatment for subsets of clients that will not find the treatment effective.

If research was performed that showed that traditional gamers do experience virtual reality differently from non-gamers and perhaps see virtual reality as an extension of video games, what does this mean? Perhaps, this is dependent on how one chooses to define virtual reality and possibly the results could change how people choose to define virtual reality in general. Generally, most definitions of virtual reality focus on whether or not a possible virtual reality system contains the correct hardware for it to be a true virtual reality system [11]. In this way, virtual reality is something of a blanket term for the systems containing a head mounted display, tracked hand controllers, or even the virtual reality rooms or caves that have been experimented with in the past. However, Jonathan Steuer from Stanford University offered a different definition of virtual reality in a 1993 paper. His proposed definition defined virtual reality as "a real or simulated environment in which a perceiver experiences telepresence" [11]. Steuer defines telepresence "as the experience of presence (the sense of being in an environment) in an environment by means of a communication medium" [11]. If one accepts a definition like this, the potential difference between traditional virtual reality defined experiences and video games can become more important. Steuer mentioned that this definition also specifies that there are different degrees of virtual reality. It is even mentioned that speaking to someone on the telephone is a type of virtual reality experience to a degree.

This definition helps make sense of why many people see virtual reality as a separate entity from video games. While someone is playing a traditional video game, they may be emotionally invested in the experience, but they are generally thought to be not experiencing full telepresence (they do not think they are in the game's environment). An ideal virtual reality system would likely invoke full telepresence in its users and they would entirely feel as though they are in the virtual environment that is being displayed to them. If experienced video game

players have less of a sense of telepresence in today's virtual reality, it could be a result of a few factors. One factor, which has been mentioned here, is that the current generation of virtual reality is fairly similar to modern video games. This is noticeable in the software and hardware required for modern virtual reality branded devices.

However, gamers could be feeling less telepresence in today's consumer virtual reality because they have simply been exposed to such similar things in their modern video games. Perhaps if non-gamers had any prolonged exposure to modern consumer virtual reality devices, they would also have the decreased telepresence that may exist in gamers. If this is true, what is the current level of telepresence and thereby virtual reality itself do the current consumer generation of virtual reality devices provide? The consumer virtual reality market and virtual reality technology in general had advanced significantly in recent years so levels of telepresence in virtual reality may quickly be improved. If there truly is a separation between how gamers and non-gamers experience virtual reality, the gap may become smaller in the coming years as this technology advances and becomes less like modern video games. However, the current generation of virtual reality devices which consist of head mounted displays projecting virtual 3D worlds while tracking a user's motions are what most of virtual reality research and development has been aiming towards. Perhaps, studying gamers' experience with these devices will help researchers find what truly is and is not effective in current virtual reality and where virtual reality should head in the future to achieve the highest levels of telepresence.

IV. Conclusion

The advancements and increase in availability of virtual reality have been astonishing in the past few years. If full telepresence is possible, virtual reality technology is getting closer to enabling this at a rapid rate. The research that has been done on virtual reality and telepresence is

not testing these hypothetical future devices, however. In fact, much of the research on virtual reality was conducted far before 2013 when virtual reality technology was drastically less advanced then it is now. One could argue that research done today could quickly become irrelevant as technology advances. However, much of the research done on virtual reality even pre-2000 still serves some purpose with today's technology. Today, the virtual reality market seems to be content with primarily focusing on gamers. This could possibly be a sound strategy. Gamers are more likely to have hardware the is compatible with virtual reality hardware and getting them to buy a virtual reality system requires less cost for the consumer. If more research was done to see how gamers and non-gamers experience virtual reality, this information could be used to shape the type of virtual reality software is produced in the coming years or perhaps encourage the virtual reality industry to focus less (or more) on gamers as an audience.

Appendix A - References

[1] R. Packer, K. Jordan, W. Gibson, and L. Anderson, Multimedia: from Wagner to virtual reality. New York: W.W. Norton & Company, 2006.

[2] "Oculus Rift: Step Into the Game," Kickstarter. [Online]. Available: https://www.kickstarter.com/projects/1523379957/oculus-rift-step-into-the-game. [Accessed: 12-Apr-2017].

[3] "The New Dawn of Virtual Reality in Health Care: Medical Simulation and Experiential Interface," Annual Review of Cybertherapy and Telemedicine, vol. 13, pp. 3–6, 2015.

[4] Boland, Daniel, and Mark Mcgill. "Lost in the rift." XRDS: Crossroads, The ACM Magazine for Students 22, no. 1 (2015): 40-45. doi:10.1145/2810046.

[5] J. Durbin, "Report: 6.3 Million Virtual Reality Headsets Shipped in 2016," UploadVR, 01-Feb-2017. [Online]. Available: https://uploadvr.com/report-6-3-million-virtual-reality-headsets-shipped-2016/. [Accessed: 25-Apr-2017].

[6] Pausch, Randy, Dennis Proffitt, and George Williams. "Quantifying immersion in virtual reality." Proceedings of the 24th annual conference on Computer graphics and interactive techniques - SIGGRAPH '97, 1997. doi:10.1145/258734.258744.

[7] Geslin, Erik, Stépgane Bouchard, and Simon Richir. "Gamers' Versus Non-gamers' Emotional Response in Virtual Reality." Journal of CyberTherapy & Rehabilitation 4, no. 4 (Winter 2011): 489-93.

[8] Garcia-Palacios, A., H. Hoffman, A. Carlin, T.a Furness, and C. Botella. "Virtual reality in the treatment of spider phobia: a controlled study." Behaviour Research and Therapy 40, no. 9 (2002): 983-93. doi:10.1016/s0005-7967(01)00068-7.

[9] Rothbaum, Barbara Olasov, Larry Hodges, Samantha Smith, Jeong Hwan Lee, and Larry Price. "A Controlled Study of Virtual Reality Exposure Therapy for the Fear of Flying ." Journal of Consulting and Clinical Psychology 68, no. 8 (December 2000): 1-11.

[10] Sargunam, Shyam Prathish, Kasra Rahimi Moghadam, Mohamed Suhail, and Eric D. Ragan. "Guided head rotation and amplified head rotation: Evaluating semi-natural travel and viewing techniques in virtual reality." 2017 IEEE Virtual Reality (VR), 2017. doi:10.1109/vr.2017.7892227.

[11] Steuer, Jonathan. "Defining Virtual Reality: Dimensions Determining Telepresence." Journal of Communication 42, no. 4 (1992): 73-93. doi:10.1111/j.1460-2466.1992.tb00812.x.